Data Bulletin

AS-Interface Spider Module

A Control Scenario Using AS-i Spider Modules with Unity™ Programming Software and an Altivar® 31C Variable Speed Drive

Retain for future use.

Overview

This bulletin introduces a more advanced control scenario for providing discrete control of an Altivar® 31C (ATV31C) variable speed drive that is not connected to an AS-Interface (Actuator Sensor, AS-i) network. Discrete control is established using an AS-Interface spider module and Unity™ programming software.

Presumption

This bulletin is written for individuals familiar with Unity™ programming software and networked ATV31C drives. If you are not familiar with this software or network operation, please consult your system administrator before attempting to setup control using a spider module.

Requirements

The following hardware and software is required:

Hardware

- 2 AS-Interface spider module, catalog number XALSZ1E
- Altivar® 31C variable speed drive
- Telemecanique® ASITERV2 programmer
- AS-Interface power supply, ASIABLB3002
- Unity Premium™ processor, TSX5730
- Unity Premium™ communications card, TSXSAY1000
- Magelis® xbtgt2220 HMI display

Software

- Unity™ programming software, version 3.0 or higher
- Vijeo® Designer programming software, version 3.0 or higher

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Safety Information

Notice

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards, or to call attention to information that clarifies or simplifies a procedure.

A lightning bolt or ANSI man symbol in a “Danger” or “Warning” safety label on the equipment indicates an electrical hazard which, as indicated below, can or will result in personal injury if the instructions are not followed.

The exclamation point symbol in a safety message in a bulletin indicates potential personal injury hazards. Obey all safety messages introduced by this symbol to avoid possible injury or death.

Symbol	Name
	Lightning Bolt
	ANSI Man
	Exclamation Point

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

CAUTION

CAUTION, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** property damage.

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Qualified Personnel

For the protection of personnel and equipment, a qualified person must perform the procedures detailed in this bulletin.

A qualified person is one who has skills and knowledge related to the construction and operation of this electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved. Refer to the most current release of NFPA 70E®, "Standard for Electrical Safety in the Workplace®," for safety training requirements.

In addition, the person must be:

- Able to read, interpret, and follow the instructions and precautions in this data bulletin and the other documentation referenced.
- Able to use the required tools listed in this data bulletin in a safe and correct manner.

Before You Begin

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guards on a machine can result in serious injury to the operator of that machine.

⚠ WARNING

UNGUARDED MACHINERY CAN CAUSE SERIOUS INJURY

- Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.
- Do not reach into machinery during operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, and government regulations. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only the user can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine; therefore, only the user can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, the user should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason, the software cannot be substituted for or take the place of point-of-operation protection.

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Ensure that the appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

Start-up and Test

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check be made and that enough time is allowed to perform complete and satisfactory testing.

⚠ CAUTION

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in injury, or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and grounds, except those grounds installed according to local regulations (according to the National Electrical Code® in the USA, for instance). If high-potential voltage testing is necessary, follow recommendations in the equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove ground from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

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Operation and Adjustments

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- “Regardless of the care exercised in the design and manufacture of equipment or in the selection and rating of components, there are hazards that can be encountered if such equipment is improperly operated.”
- “It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer’s instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer’s instructions and the machinery used with the electrical equipment.”
- “Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.”

Related Documents

Title of Documentation	Reference Number
XALSZ1E AS-Interface Spider Module Instruction Sheet	W916901430111
Altivar® 31C Installation Manual	atv31C_installation manual_EN_V3
Altivar® 31 Programming Manual	VVDED303042US
Altivar® 31 Installation Manual	VVDED303041US
Altivar® 31 Adjustable Speed Drives: Supplementary Instructions to Altivar 31C IP54 Type 12 Installation Manual	30072-451-94
Altivar® 31 Adjustable Speed Drives: Addendum to the Programming and Installation Bulletins for Version S320	30072-451-80
ASITERV2 Adjustment and Diagnostic Console User’s Manual	W916939360111

You can download these technical publications and other technical information from our website at www.us.schneider-electric.com.

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Product Related Information

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment. Disconnect the power at the processor and at the power source.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.
- Confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link. [1]
- Each implementation of an Altivar 31C drive must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

1. For additional information refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems."

User Comments

We welcome your comments about this bulletin. You can reach us by e-mail at oem.solutions@us.schneider-electric.com.

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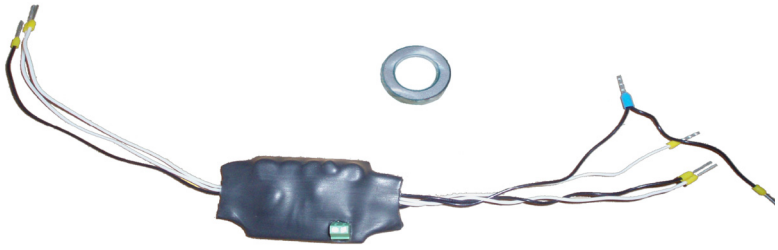
Product Description

AS-Interface Spider Module

The AS-Interface spider module allows simple, discrete control of a piece of equipment that is not connected to an AS-i network. The spider module allows connection of simple field I/O devices, such as: push button and LED type devices, in discrete process applications using a single two-conductor cable.

The spider module, named for its appearance, is a small, encapsulated circuit board with two inputs and two outputs, encased in a thick heat shrink tube. Its small size allows for internal mounting within another device. Figure 1 shows the spider module along with the ferrite core that also comes in the product kit.

Figure 1: AS-Interface Spider Module



Features

The spider module offers the following key features:

- Two short-circuit protected discrete inputs
- Two current-limited discrete outputs
- Voltage for the inputs and outputs derived from the AS-i power supply, with the network information decoupled
- Input and output voltages 2–3 V less than the nominal AS-i voltage (30 V AS-i bus)
- A small two-position screw connector for attaching to the AS-i bus

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Altivar® 31C Variable Speed Drive

The ATV31C is an enclosed version of the ATV31 variable speed drive. At its core is an ATV31 drive with a plastic enclosure, an attached aluminum heat sink, and an internal fan. Figure 2 shows the discrete I/O terminal locations of the ATV31 drive and Table 1 shows the input specifications.

Discrete terminal inputs control the drive's forward direction, reverse direction, and speed. In this control scenario, the spider module must be able to:

Control the forward and reverse direction of the motor

Switch among four different drive speeds

Determine whether the motor is running

Determine whether the drive has detected a tripped condition

The spider module must also be able to control the inputs in accordance with the safety and reliability requirements of the drive. As Table 1 shows, the voltage range of a spider module output (2 – 3 V below 30 V) controlling an ATV31 input falls within the acceptable range. Also, with an input impedance of 3.5 kΩ, the worst-case current requirement for a spider module output is less than 10 mA.

Figure 2: ATV31 I/O Terminals

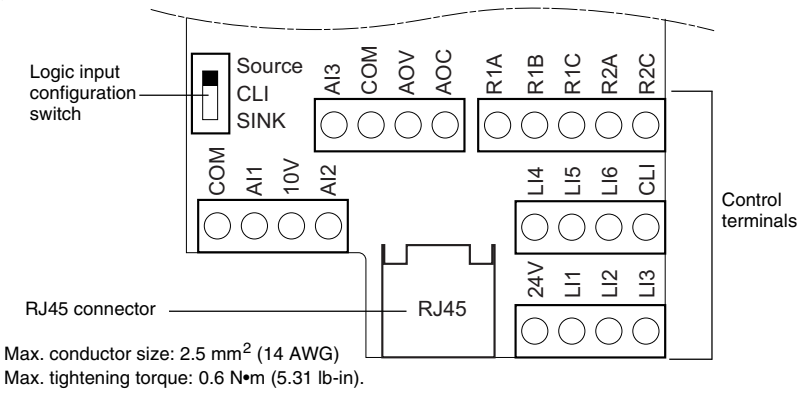

Table 1: ATV31 Input Specifications

Terminal	Function	Electrical characteristics
24 V	Logic input power supply	+ 24 V protected against short circuits and overloads, 19 V min., 30 V max. Max. available current is 100 mA.
LI1 LI2 LI3	Logic inputs	Programmable logic inputs • + 24 V power supply (30 V max.) • Impedance: 3.5 kΩ • State 0 if the voltage difference between LI and CLI is < 5 V State 1 if the voltage difference between LI and CLI is > 11 V • Sampling time: 4 ms

In the control scenario described in this document:

Two spider modules are used for drive input control.

The relay outputs of the ATV31 drive send the following signals to the spider modules:

— Motor running

— Drive detected a tripped condition

The inputs of the ATV31C drive are set to Source Current (default).

An M12 connector provides the AS-Interface bus connection to the spider modules inside the drive enclosure.

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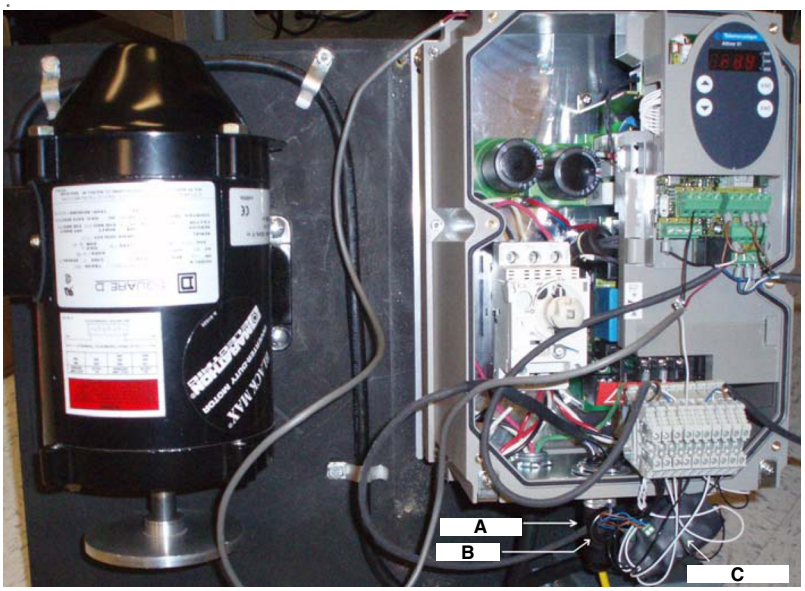
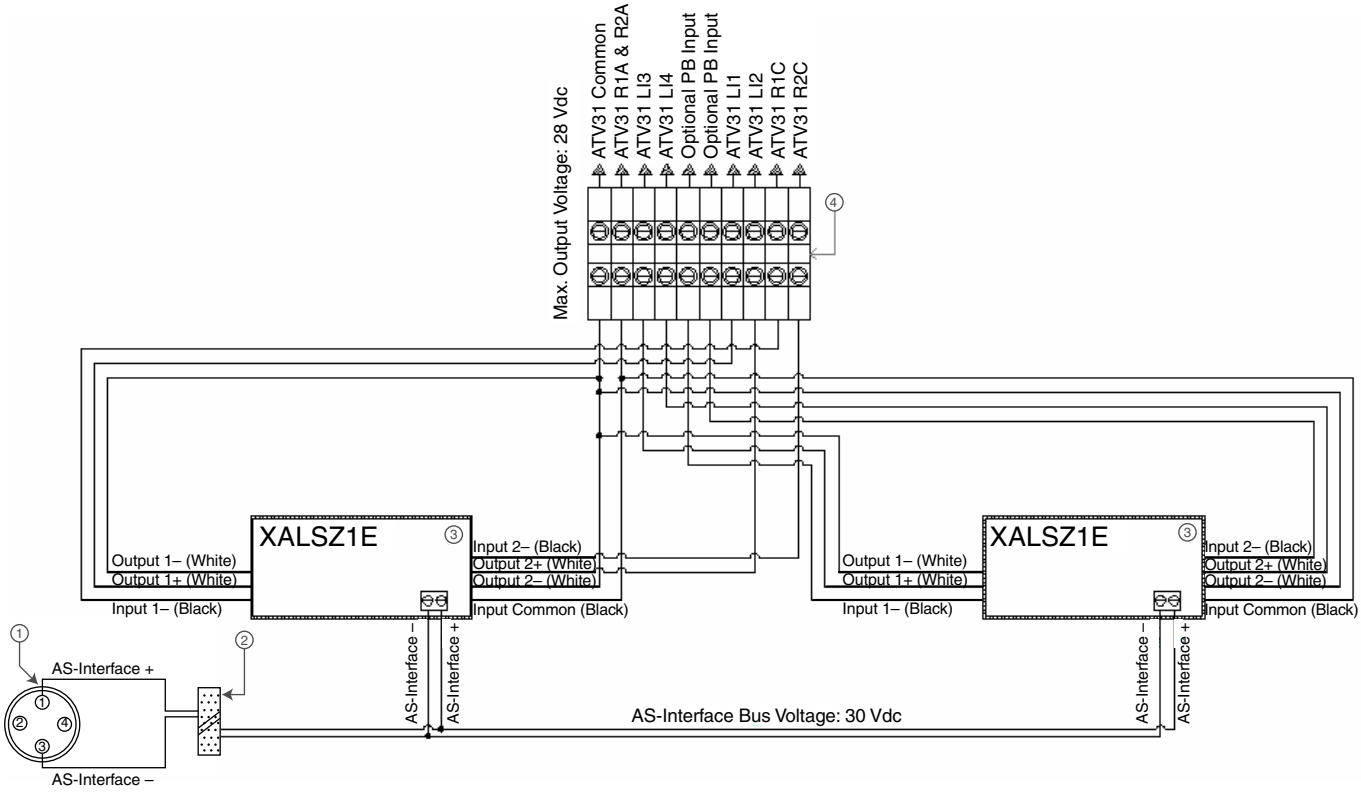
Figure 3 shows the spider modules wired into the drive. Figure 4 shows the wiring schematic.

Figure 3: ATV31C Drive with Wired AS-Interface Spider Modules



Callout	Description
A	M12 Connector
B	Ferrite Ring
C	Spider Module

Figure 4: Wiring Schematic: AS-Interface Spider Module to ATV31C Drive



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Programming

AS-Interface Spider Modules

The default AS-Interface address of the spider modules is internally set to 0. The control scenario described here uses a Telemecanique® ASITERV2 programmer as a master device to program the spider modules to the desired addresses.

The ASITERV2 programmer is an AS-Interface master in a convenient, voltmeter-type package. It can analyze, read, and write to AS-i devices. In this scenario, two functions are used:

Address function: sets the spider module address

Profile function: reads the AS-Interface profile sequence from the device

For instructions on using the ASITERV2 programmer, refer to instruction bulletin W916939360111, *ASITERV2 Adjustment and Diagnostic Console User's Manuals*.

Setting the Address

Follow the steps below to set the spider module address. In this example, one spider module is set to address 3, and the other to address 4.

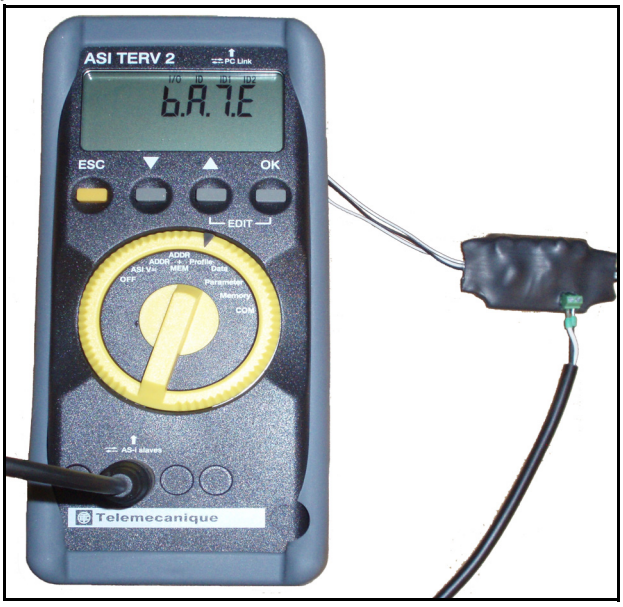
1. Connect the ASITERV2 programmer to the spider module.
2. Following the instructions in the ASITERV2 user's manual, place the programmer in address mode (A d d r E S is displayed).
3. Use the Up and Down arrow keys to set the desired address.
4. Press OK to program the device.

Reading the AS-Interface Device Profile

The Unity™ AS-Interface profile library contains the device profiles for most Telemecanique AS-Interface products. However, it does not contain the device profile for the XALSZ1E spider module. (The XALSZ1 profile under the Push Button family is **not** correct for the XALSZ1E spider module.)

Figure 5 shows the ASITERV2 programmer reading the profile (BA7E) from a spider module. Using this profile, you can create a new software item. See "Creating the AS-i Profile in Unity™ Programming Software" on page 12.

Figure 5: ASITERV Programmer Connected to the Spider Module



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Altivar® 31C Variable Speed Drive

To permit control by the spider module, the ATV31C drive must be configured for terminal control mode. Table 2 describes other important settings.

Table 2: Drive Settings

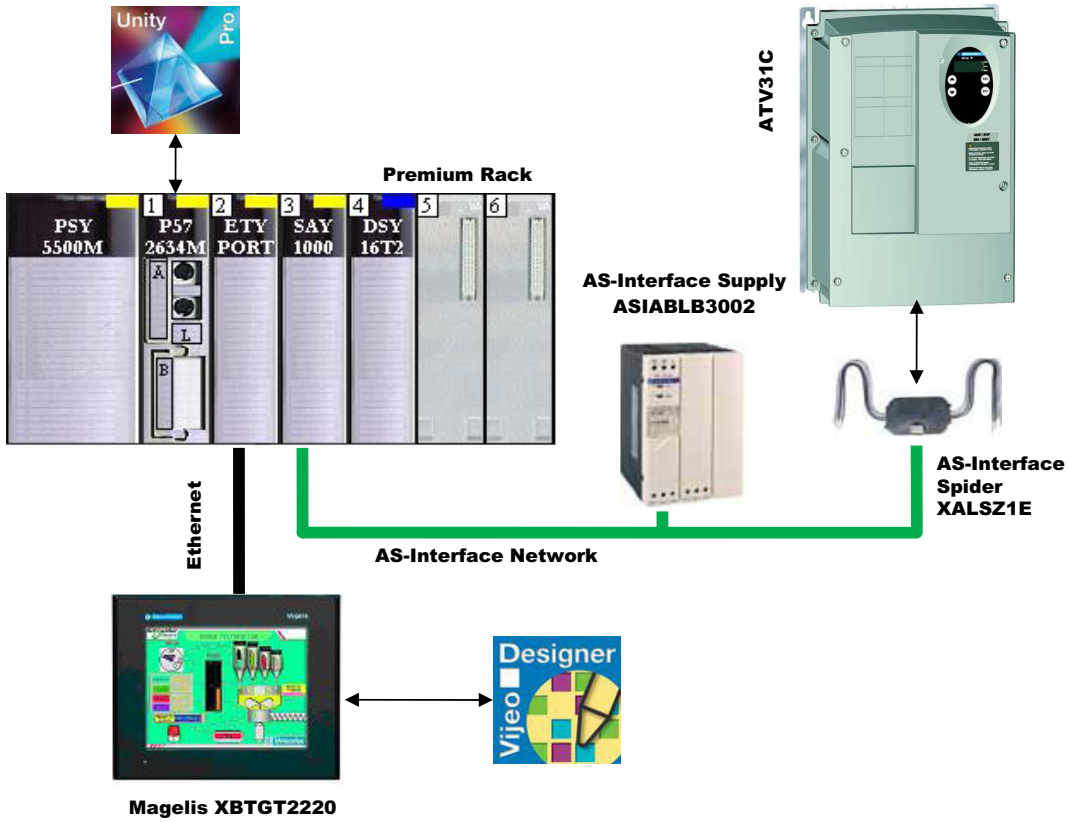
Menu Location	Setting	Comment
Set ◊ LSP	5.0 Hz	Base speed of the motor in the lowest speed setting
I_O ◊ TCC	2C	Two wire control
I_O ◊ R1	FLT	Relay 1 changes state when the drive detects a tripped condition
I_O ◊ R2	RUN	Relay 2 changes state when the motor is running
FUN ◊ PSS ◊ PS2	LI3	LI3 is set to the low bit of the speed matrix
FUN ◊ PSS ◊ PS4	LI4	LI4 is set to the high bit of the speed matrix
FUN ◊ PSS ◊ SP2, SP3, and SP4	Varies	The three speed settings (in Hz) in addition to the LSP setting above. The settings are application-specific.

Setting up the Test Application Hardware

Figure 6 shows an overview of the setup used to test the AS-Interface control of the ATV31C drive. In addition to the components already discussed, the setup includes:

- ASIABLB3002 AS-Interface power supply, essential for powering the network (+30 Vdc)
- TSX5730 Premium™ processor with the TSXRKY8 rack
- TSXSAY1000 Premium™ communications card, the interface between the processor and the AS-i network
- Magelis® XBTGT2220 HMI display, used as a simple testing interface

Figure 6: Hardware Setup for the Test Application



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Creating the AS-i Profile in Unity™ Programming Software

The section “Reading the AS-Interface Device Profile” on page 10 describes how to obtain the spider module profile using the ASITERV2 programmer. Using this profile, you can create a new XALSZ1E device in the Unity programming software.

1. Double-click the ASi-V2 icon in the project browser.

   The AS-Interface network information screen appears, showing the TSXSAY1000 module information. See Figure 7.

2. Double-click the appropriate address in the list box (in this scenario, addresses 3 and 4).

   The Associate Profile dialog box appears.

3. Select Private family from the AS-interface profile families list, then click Add and then OK.
4. Fill out the fields in the Define AS-Interface Profile dialog box. See Figure 8 on page 13.
   a. Name the profile with the spider module catalog number.
   b. Add a Comment, if desired.
   c. Enter the device Profile, as read using the ASITERV2 programmer.
5. Click OK.

Once the profile is defined, you can add the spider modules to the network at addresses 3 and 4. See Figure 9 on page 14.

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Figure 7: Setting up AS-Interface Devices in Unity Software

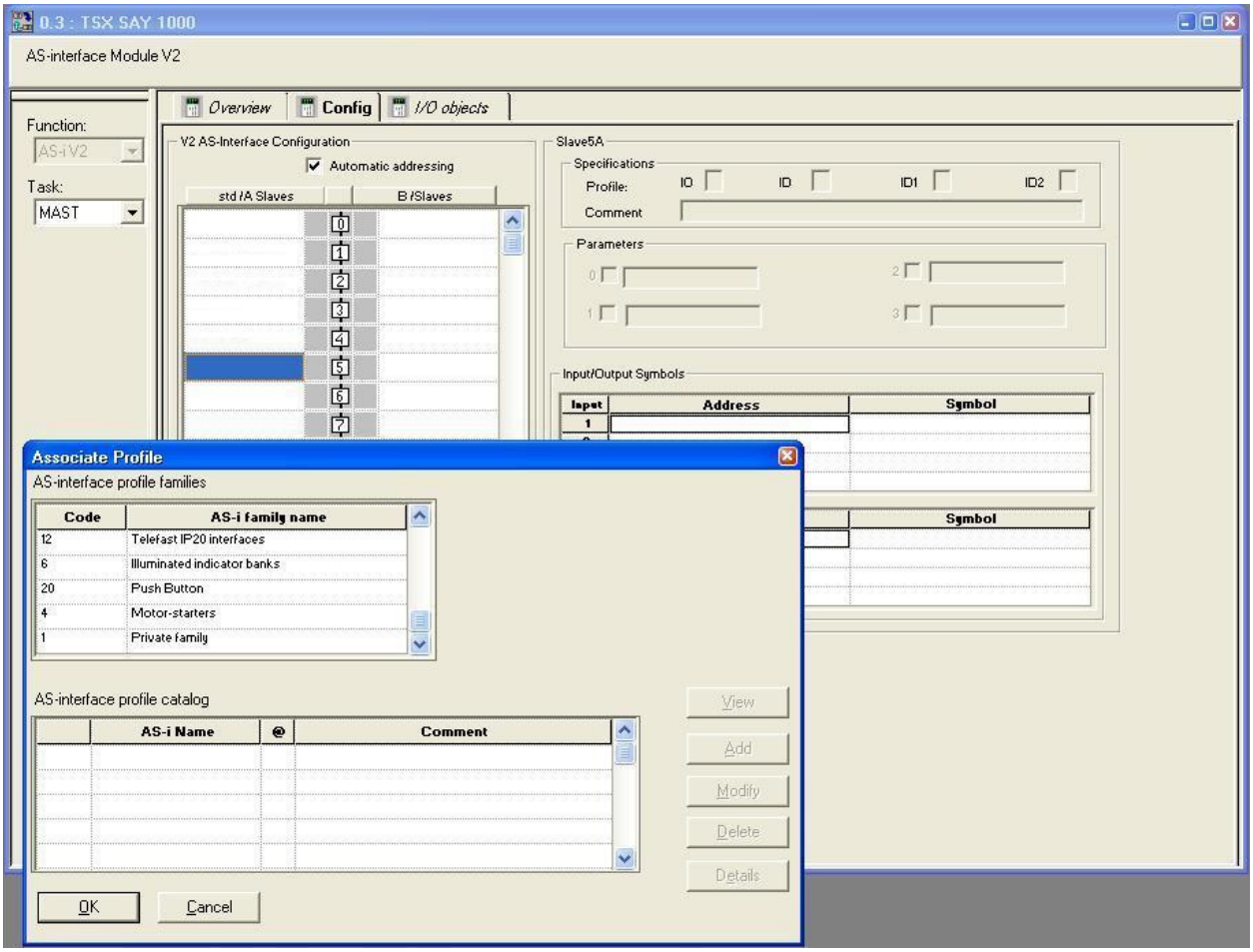

Figure 8: Creating a New AS-Interface Device in Unity™ Software

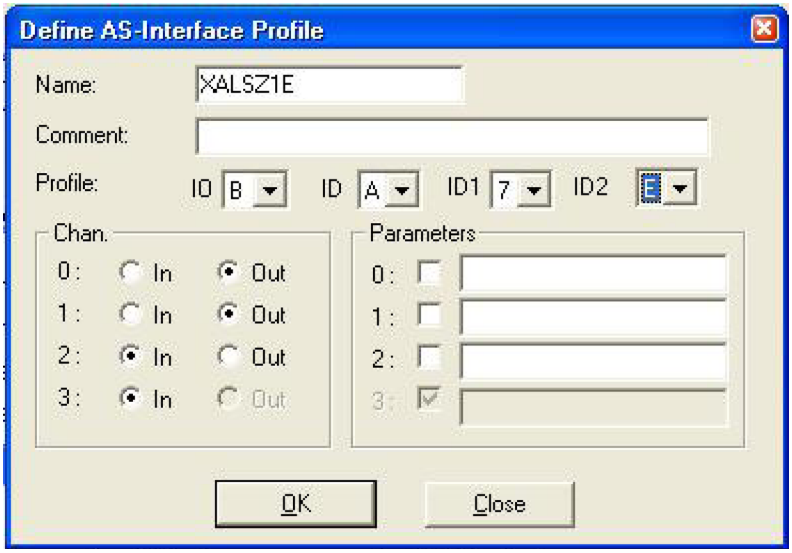

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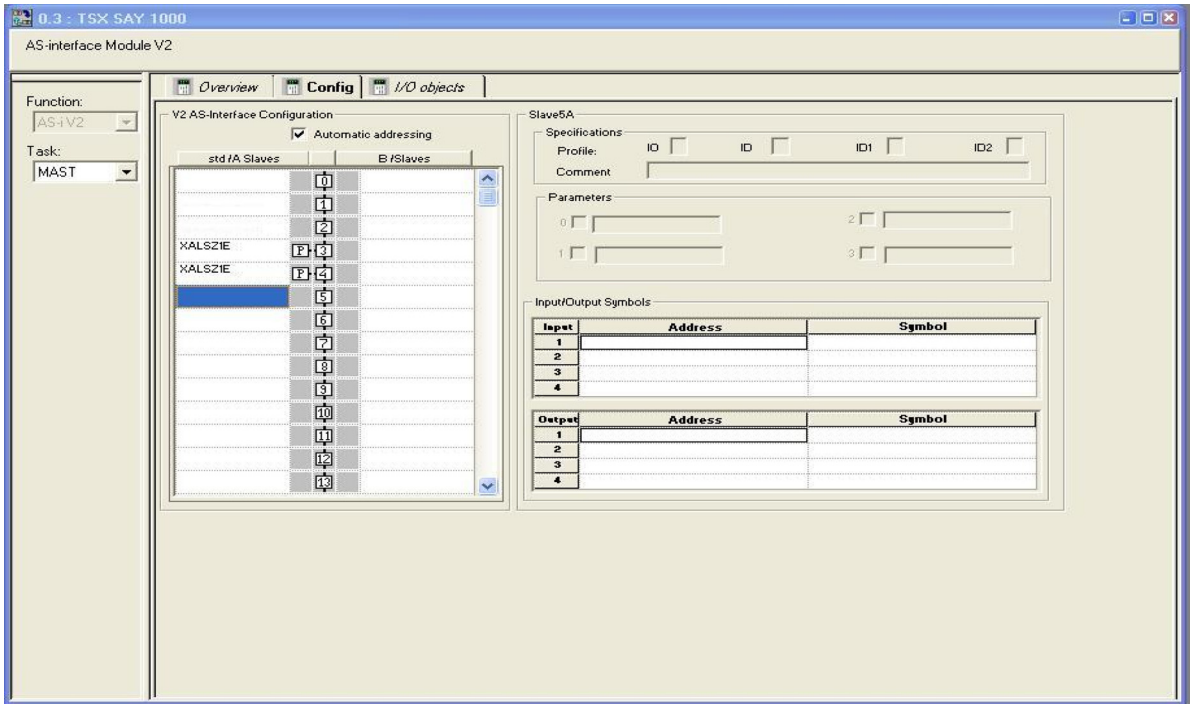
Figure 9: AS-Interface Spider Slave Modules



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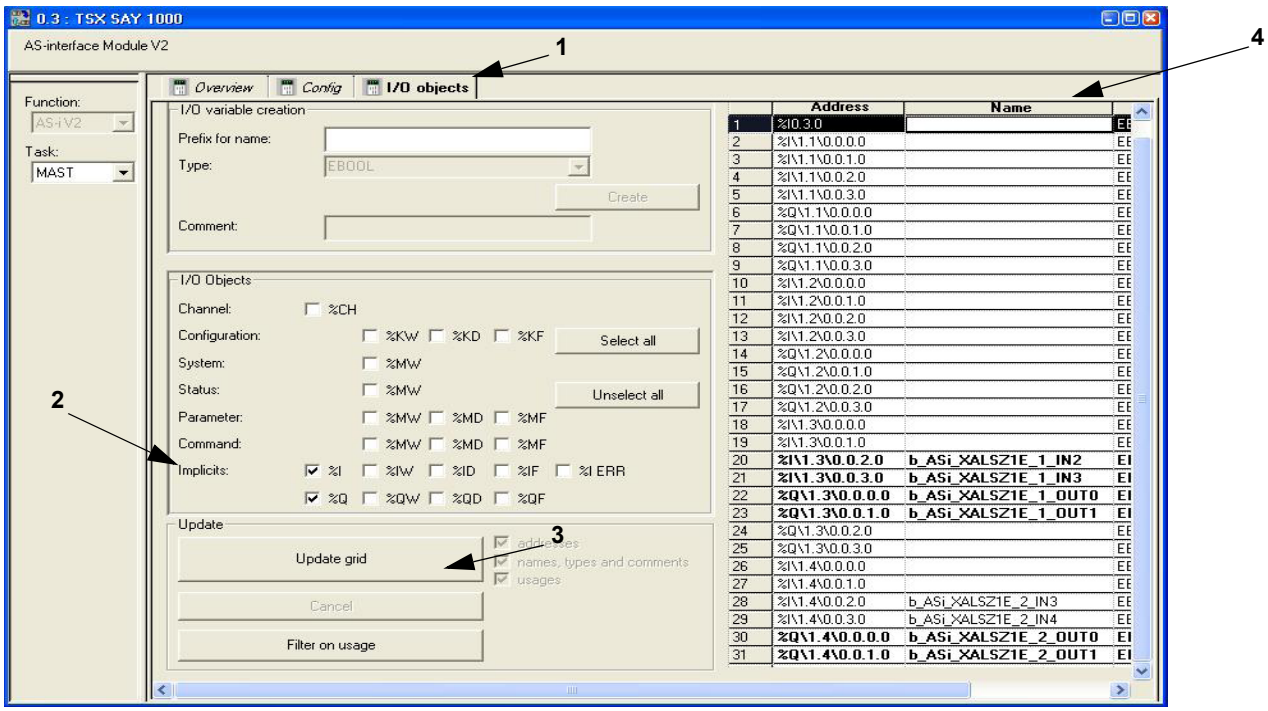
The actual discrete I/O points can be individually named for use in the controller program. Refer to Figure 10 as necessary while performing the following procedure.

1. Click the I/O Objects tab.
2. Check I/O Object Implicits %I or %O.
3. Click Update Grid.
4. In the Address / Name pane, assign a name to the I/O point.

Figure 10: Naming the Individual Discrete I/O Points



Creating an ATV31C AS-i Derived Function Block

The scenario described in this document requires the following functionality:

Selection of forward, reverse, and speed via an HMI.

Monitoring the event status of the drive, and prohibiting the motor from running if the controller detects a tripped condition.

Verifying that the motor starts when a forward or reverse command is initiated.

Signaling the HMI if the drive detects a tripped condition, or if the motor does not start.

Program this functionality into the device by creating a Derived Function Block (DFB). Figure 11 on page 16 shows the input, output, and variable structure of the DFB.

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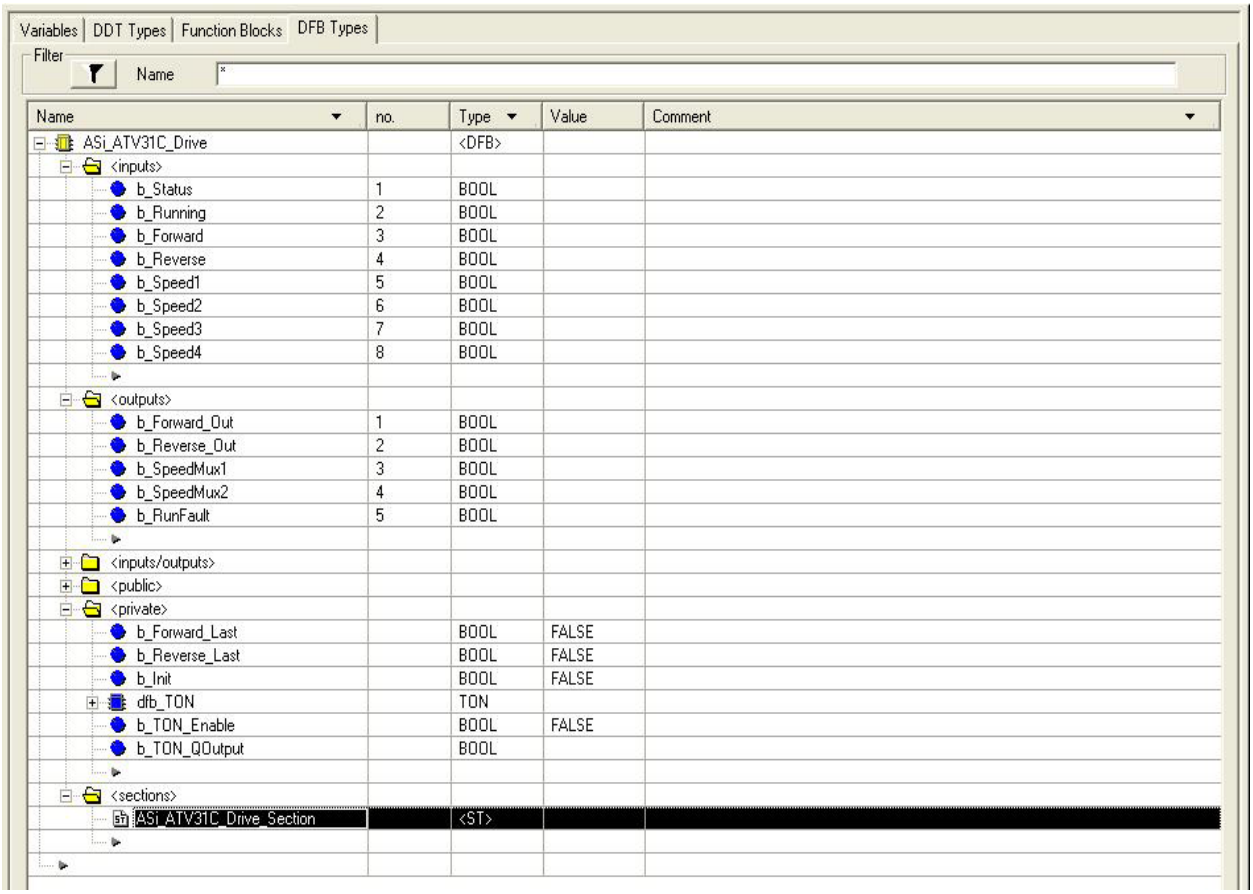
Figure 11: Encapsulated DFB for Controlling the AS-Interface ATV31C Drive



The sample code below and on page 17 shows the structured text code for the derived function block. This code is designed to achieve the following:

Force the mutual exclusivity of the reverse and forward functions.

Control the output speed matrix.

In the private variable section, instantiate an EFB (Elementary Function Block).

Using the TON object, establish a time-out period for verification that the motor is running.

Ensure that the DFB initiates a master run event if the motor does not begin to run before the time-out period expires .

Sample Code: Structured Text Code for the Created DFB

```
(* Verify initialization condition. *)
IF NOT b_Init THEN
    b_Forward_Out := FALSE; b_Forward_Last := FALSE;E
    b_Reverse_Out := FALSE; b_Reverse_Last := FALSE;
    b_SpeedMux1 := FALSE; b_SpeedMux2 := FALSE;
    b_TON_Enable := FALSE; b_TON_QOutput := FALSE;
    b_Init := TRUE;
    return;
END_IF;
```

Continued on next page

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Sample Code: Structured Text Code for the Created DFB *(continued)*

```
      (* Local run timer. *)
dfb_TON(IN:=b_TON_Enable, PT:=T#1S, Q=>b_TON_QOutput);

(* Check status to activate. *)
IF NOT b_Status THEN
      (* We are not active. *)
      b_Forward_Out := FALSE; b_Forward_Last := FALSE;
      b_Reverse_Out := FALSE; b_Reverse_Last := FALSE;
      b_TON_Enable := FALSE;
ELSIF b_Forward <> b_Forward_Last THEN
      (* Equalize the members. *)
      b_Forward_Last := b_Forward;
      b_Forward_Out := FALSE;
      (* See if we should activate the output. *)
      IF b_Forward AND NOT b_Reverse THEN
            b_Forward_Out := TRUE;
            b_TON_Enable := TRUE;
            b_RunFault := FALSE;
      END_IF;
ELSIF b_Reverse <> b_Reverse_Last THEN
      (* Equalize the members. *)
      b_Reverse_Last := b_Reverse;
      b_Reverse_Out := FALSE;
      (* See if we should activate the output. *)
      IF b_Reverse AND NOT b_Forward THEN
            b_Reverse_Out := TRUE;
            b_TON_Enable := TRUE;
            b_RunFault := FALSE;
      END_IF;
END_IF;

(* Check the status run input and timer. *)
IF b_Running THEN
      b_TON_Enable := FALSE;
ELSIF b_TON_QOutput THEN
      (* The timer has expired and this is a fault condition. *)
      b_Reverse_Out := FALSE; b_Forward_Out := FALSE;
      b_TON_Enable := FALSE; b_TON_QOutput := FALSE;
      b_RunFault := TRUE;
END_IF;

(* Check the input speed. *)
IF b_Speed2 THEN
      b_SpeedMux1 := TRUE; b_SpeedMux2 := FALSE;
ELSIF b_Speed3 THEN
      b_SpeedMux1 := FALSE; b_SpeedMux2 := TRUE;
ELSIF b_Speed4 THEN
      b_SpeedMux1 := TRUE; b_SpeedMux2 := TRUE;
ELSE
      b_SpeedMux1 := FALSE; b_SpeedMux2 := FALSE;
END_IF;
```

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The Unity™ Test Program

Based on the DFB created from the code in the sample code on page 16, the actual function block program is small. Figure 12 shows the Unity program in its entirety. The HMI variables should be self-explanatory, however, the following variables need further explanation:

`b_ASi_XALSZ1E_1_IN3`:
This is the spider module input from relay 2 of the drive. When active, it signals that the motor is running.

`b_ASi_XALSZ1E_1_IN2`:
This is the spider module input from relay 1 of the drive. When off, it signals that an event has been detected.

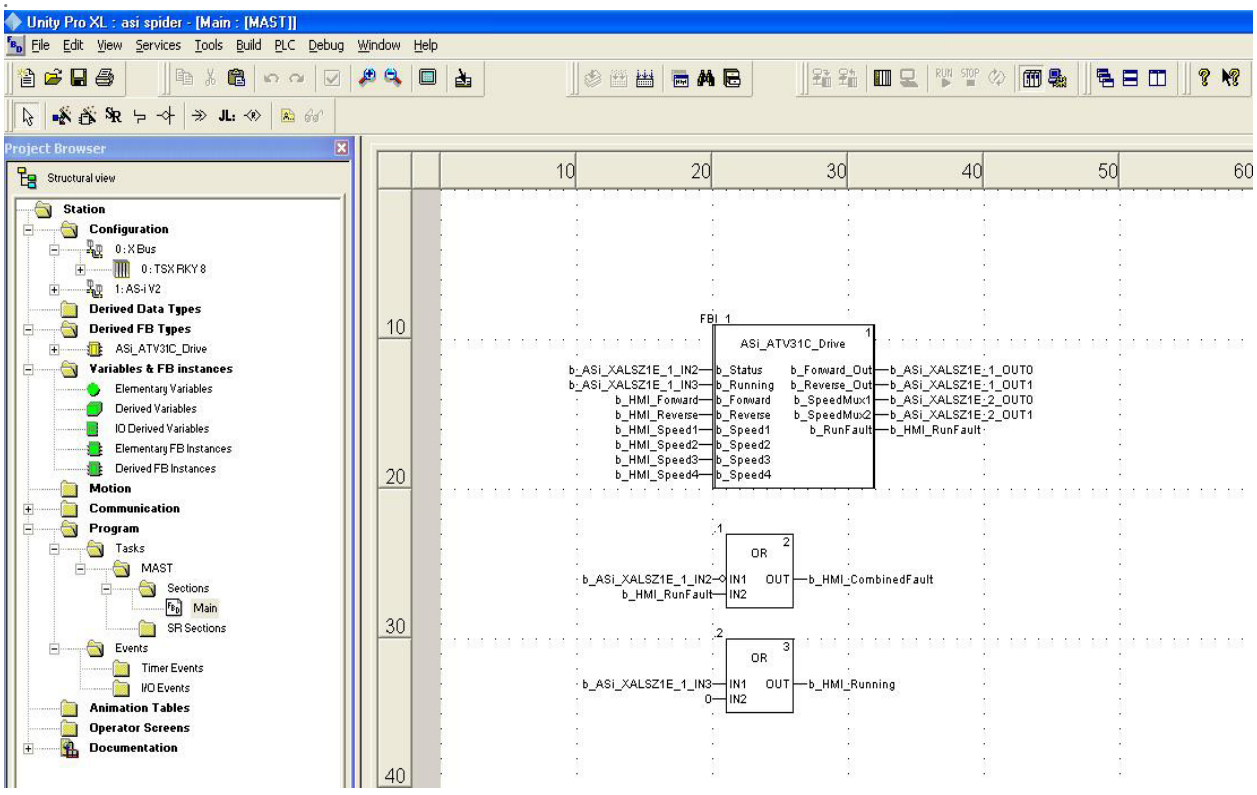
`b_ASi_XALSZ1E_1_OUT0`:
This is the spider module output into LI1 of the drive (forward).

`b_ASi_XALSZ1E_1_OUT1`:
This is the spider module output into LI2 of the drive (reverse).

`b_ASi_XALSZ1E_2_OUT0`:
This is the output of the secondary spider module that connects to the low bit (LI3) of the speed multiplex.

`b_ASi_XALSZ1E_2_OUT1`:
This is the output of the secondary spider module that connects to the high bit (LI4) of the speed multiplex.

Figure 12: Unity Test Application



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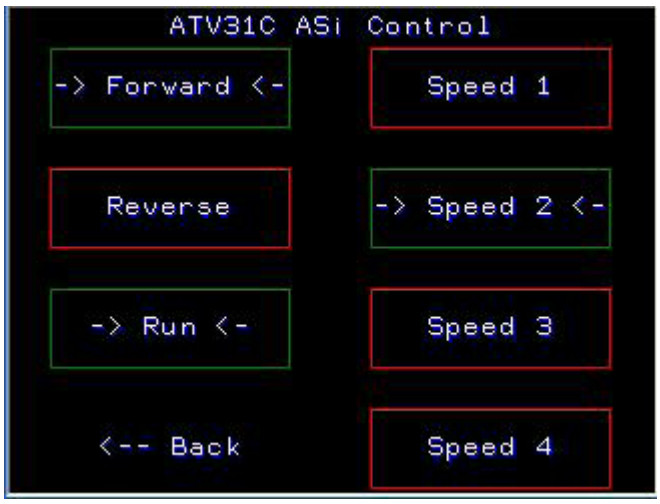
The Magelis® Interface Program

Using Vijeo® Designer software, you can create a simple interface program. This example uses a single-screen program that allows interaction with the DFB described in “Creating an ATV31C AS-i Derived Function Block” on page 15. The Magelis XBTGT communicates with the Unity Premium™ processor via Ethernet using Modbus® TCP protocol. Figure 13 shows the Magelis screen in operation.

Figure 13: Magelis Screen for AS-Interface Control of the ATV31C Drive



Running the Drive

The HMI program described above provides the following functionality:

- Varying drive speeds from LSP (which for this example was set to 5 Hz) up to the speed 4 setting (30 Hz).
- Reversing drive direction

By varying the acceleration and deceleration ramp times, you can achieve a very quick response time.

Other Applications

While this scenario used two spider modules, a simple start/stop control application would require only one. Alternatively, adding a third spider module would allow additional functionality (for instance, up to 16 speeds, or control over ramp switching). With the configuration used in this document, two inputs went unused. These could serve as a mechanical push button or photoelectric switch input.

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Schneider Electric
8001 Knightdale Blvd
Knightdale, NC 27545 USA
1-888-SquareD
(oem.solutions@us.schneider-electric.com)

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